DO DROWSY DRIVER DRUGS DIFFER?

Timothy Brown[1], Andrew Spurgin[12], Gary Milavetz[12], Gary Gaffney[13], Robin Johnson[4]

[1]National Advanced Driving Simulator, University of Iowa, [2]College of Pharmacy (UI) , [3]Carver College of Medicine(UI) , [4]Advanced Brain Monitoring

ABSTRACT

This research paper explores how different drug mechanisms within a single class of drugs can produces different profiles of driving impairment. Prior research has failed to consider these mechanistic differences and often utilizes less controlled study methodologies. The potential impact of differing mechanistic effects is important for practitioners but remains unclear for most drugs.

Twenty-nine licensed drivers in good general health completed one of two miniSim™ studies using a validated, standardized, driving impairment scenario. Both drugs caused degradation in lateral control measures of standard deviation of lane position (SDLP) and number of lane departures, however only diphenhydramine was found to cause a significant change in steering bandwidth. The studied drugs differed in their effects on all longitudinal driving measures with diphenhydramine effecting speed and alprazolam effecting the standard deviation of speed. Difference in therapeutic mechanism of action results in differing pharmacodynamic driving performance outcomes.

This analysis reinforces the importance of careful consideration of a drug's specific mechanism of action when considering a sedating drug's impact on a patient's ability to safely operate a motor vehicle.

Figure 1. NADS miniSim.

CONTACT

Timothy Brown, Ph.D.
National Advanced Driving Simulator
Email: timothy-l-brown@uiowa.edu
Phone: 319-335-4785
Website: www.nads-sc.uiowa.edu

INTRODUCTION

- Almost ½ of the population of the US using at least one prescription drug in the past month, and over 1/5 using at least 3
- Rise in the number of people driving while under the influence of medications
- Some of these drugs affect driving performance
- There is limited information regarding the pharmacodynamic effects of drugs on driving performance
- No regulatory requirements to investigate the effects
- Physicians and pharmacists are required to counsel patients on medications that may cause the side effects of drowsiness, dizziness or altered mental acuity.
- Consultation is that the drug may impair driving performance, and that they should not operate heavy machinery until they know how they drug is going to affect them individually

Research Question

Is the same advice warranted for all drugs that cause drowsiness?
- Does the mechanism matter?

Methods

Data used from two studies with similar procedures and same driving scenario
- 20 (12 male, 8 female, mean age 25.2yo) subjects participated in a study looking at the effects of alprazolam (Xanax®)
- 9 (3 male, 6 female, mean age 33.6yo) subjects participated in a study looking at the effects of diphenhydramine (Benadryl®)

The 35-40 minute driving scenario consisted of three approximate 10-minute segments of urban, interstate and rural driving followed by a ten-minute straight rural driving environment.

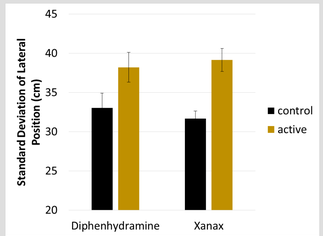
The **diphenhydramine** arm was baseline controlled.
- Two drives during the visit.
- Drive. Study Drug. Wait to peak. Drive.

The **alprazolam** arm was placebo controlled
- One drive per visit. Two visits.
- Dose (placebo or drug). Wait to peak. Drive.

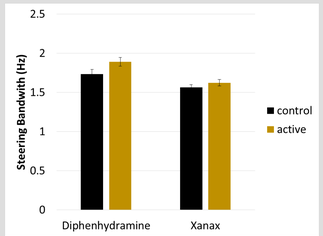
Figure 2. Sample Simulator Images.

RESULTS

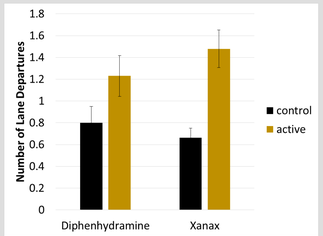
		Diphenhydramine		Alprazolam	
		p	Cohen's d	p	Cohen's d
Lateral Control	Average Lane Position	0.4544	0.08	0.3163	0.06
	Standard Deviation of Lane Position	0.0300	0.47	0.0003	0.57
	Steering Bandwidth	0.0289	0.42	0.3216	0.16
	Number of Lane Departures	0.0081	0.38	0.0041	0.60
Longitudinal Control	Average Speed relative to the Speed Limit	0.0200	0.51	0.1313	0.30
	Standard Deviation of Speed	0.5228	0.14	0.0392	0.19
	Percent Speed High	0.0176	0.43	0.1593	0.18
	Percent Speed Low	0.2732	0.20	0.6774	0.07



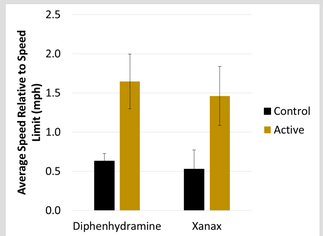
Figures 3. Increased Weaving.



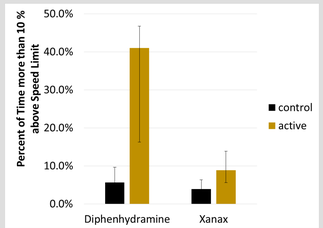
Figures 4. Increased Weaving.



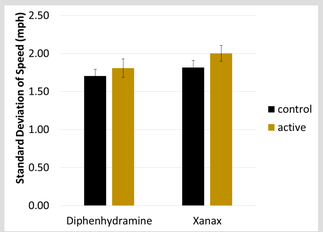
Figures 5. More Lane Departures.



Figures 6. Driving Faster.



Figures 7. But not the Same .



Figures 8. And with Different Variability.

CONCLUSIONS

- Effects are not the same for both drugs

	Diphenhydramine	*Alprazolam*
Standard Deviation of Lane Position	↑	↑
Steering Bandwidth	↑	
Number of Lane Departures	↑	↑
Average Speed relative to the Speed Limit	↑	↑
Percent Speed High	↑	
Standard Deviation of Speed		↑

- The drowsiness induced by diphenhydramine is most often described as a **generalized desire to sleep**. Individuals on this drug are often very aware of this effect and may be compensating by an increased frequency of steering input.
- The drowsiness induced by alprazolam is most often described as a **general relaxation**. Individuals on this drug may not be cognizant of the impairing effects while on the drug by nature of its therapeutic action (anxiolytic). In this state, these individuals would exhibit less compensatory action that results in less precise control consistent with the changes observed.

NEXT STEPS

- Study additional drowsiness inducing drugs
- Explore EEG data to better understand effects while driving
- Extend standardized protocol to other classes of drugs.

ACKNOWLEGEMENTS

The National Institutes of Drug Abuse funded this research under contract numbers: HHSN271201100009C and HHSN27120100019C. These findings represent the views of the authors. The authors would like for further recognize Chris Schwarz, NADS, and Chris Berka for their contribution to this research.